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Review Article

Syntactic Versus Memory Accounts of the Sentence Comprehension Deficits of Specific Language Impairment: Looking Back, Looking Ahead

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Purpose: Compared with same-age typically developing peers, school-age children with specific language impairment (SLI) exhibit significant deficits in spoken sentence comprehension. They also demonstrate a range of memory limitations. Whether these 2 deficit areas are related is unclear. The present review article aims to (a) review 2 main theoretical accounts of SLI sentence comprehension and various studies supporting each and (b) offer a new, broader, more integrated memory-based framework to guide future SLI research, as we believe the available evidence favors a memory-based perspective of SLI comprehension limitations.

Method: We reviewed the literature on the sentence comprehension abilities of English-speaking children with SLI from 2 theoretical perspectives.
Results: The sentence comprehension limitations of children with SLI appear to be more fully captured by a memory-based perspective than by a syntax-specific deficit perspective.
Conclusions: Although a memory-based view appears to be the better account of SLI sentence comprehension deficits, this view requires refinement and expansion. Current memory-based perspectives of adult sentence comprehension, with proper modification, offer SLI investigators new, more integrated memory frameworks within which to study and better understand the sentence comprehension abilities of children with SLI.

Children with specific language impairment (SLI) demonstrate normal-range nonverbal intelligence, hearing sensitivity, and articulation and no neurological impairment or developmental disability, yet they show significant language problems for their age. These children exhibit marked spoken sentence comprehension deficits and show a range of cognitive impairments—chief among them, memory. Whether these children's comprehension difficulties are related to their memory limitations is not clear. In this review article, we (a) review the two historical accounts of SLI sentence comprehension deficits and various studies corresponding to each and (b) propose a new, broader, and integrated memory-based theoretical framework motivated by the adult sentence comprehension literature, as well as the SLI literature, that should prove useful for guiding future research into the sentence comprehension abilities of children with SLI. (See online Supplemental Materials S1 for a list of articles related to the syntax-based account and memory-based account of SLI sentence comprehension.)

Compared with our understanding of SLI expressive abilities, understanding of these children's sentence comprehension abilities is relatively sparse. Deeper knowledge of these children's comprehension is greatly needed. First, sentence comprehension is a challenging feat because children must incrementally build and integrate structure and meaning in the moment from a rapidly disappearing signal. Research designed to identify the linguistic and memory mechanisms supporting comprehension is instrumental to advancing our understanding of the nature of SLI sentence comprehension limitations. Doing so has important implications for developing theoretically motivated and empirically grounded accounts of comprehension. To date, such accounts are few and underspecified, although a syntax-specific deficit view appears to be better articulated than any alternative proposals. Second, children with receptive–expressive deficits

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are at greater risk for academic failure than those with just expressive deficits (Conti-Ramsden, Durkin, Simkin, & Knox, 2008), and spoken sentence comprehension is a good predictor of reading comprehension (Botting, Simkin, & Conti-Ramsden, 2006; Scott, 2009). Third, interventions designed to treat SLI sentence comprehension deficits are very few (e.g., Ebbels, 2007). The lack of treatment approaches is unfortunate, too, because children with receptive–expressive deficits respond less favorably overall to intervention than children with expressive-only deficits (Bishop, Adams, & Rosen, 2006; Cirrin & Gillam, 2008; Law, Garrett, & Nye, 2004).

Looking Back: Two Accounts of SLI Sentence Comprehension Deficits

Children with SLI exhibit broad sentence comprehension deficits. They have difficulty understanding syntactically complex structures as well as simple structures. Two main theoretical perspectives historically have been advanced to explain the sentence comprehension deficits of SLI: a syntax-specific deficit view and a working memory (WM)–based account. On the basis of the available evidence, the broad profile of SLI sentence comprehension limitations appears to be better supported by a memory-based perspective than by a purely syntax-specific deficit account.

In this review article, we focus on the purported syntactic processes and potential memory abilities supporting SLI sentence comprehension with the aim of more fully characterizing the nature of the sentence comprehension abilities of children with SLI. We compare the comprehension of children with SLI with that of same-age typically developing (TD) peers and younger children, usually matched on vocabulary and/or verbal short-term memory (STM). Although we favor a memory-based view, we recognize the limitations of this account in its present form. We thus end by offering (a) a new, broader, more theoretically integrated memory framework that is motivated by the adult sentence comprehension literature but also informed by the SLI literature and (b) a stepwise study approach that may be useful for guiding future research on SLI sentence comprehension.

Syntax-Specific Deficit Account

Some of the earliest reports of sentence comprehension problems in SLI were provided by Bishop (1979, 1982). However, it was van der Lely and colleagues who were the first to offer a theoretical explanation of these children's deficits. These authors proposed a linguistic-specific account, arguing that these children have trouble computing nonlocal, long-distance syntactic dependencies between sentence constituents in complex structures requiring binding or syntactic movement. For movement-derived structures, these authors proposed the computational grammatical complexity (CGC) hypothesis (Marinis & van der Lely, 2007; Marshall, Marinis, & van der Lely, 2007; Marshall & van der Lely, 2006; van der Lely, 2005), a descendant of their representational deficit for dependent relationships hypothesis (van der Lely, 1994, 1996, 1998; van der Lely & Battell, 2003; van der Lely & Stollwerck, 1997). The heart of the claim is that the representation and/or mechanisms responsible for building hierarchical grammatical structures are not obligatorily used by children with SLI. Instead the children treat movement as optional and therefore are inconsistent in making the necessary movement and/or proper thematic role assignments to each noun phrase (NP) to ensure the recovery of a subject–verb–object (SVO) representation of sentence meaning. The CGC hypothesis has been used to explain the difficulty children with SLI have comprehending and producing complex structures, thereby implicating that deficient syntactic knowledge is responsible for both their comprehension deficits and their production deficits. The vast majority of SLI studies documenting these children's sentence comprehension deficits have focused on the comprehension of pronominals/reflexives, passives, object relatives, and *wh*-questions.

Pronominal and Reflexive Sentences

A syntax-specific deficit account predicts that children with SLI should have more difficulty than same-age TD peers comprehending sentences containing a pronominal reference (*Daffy Duck says Bugs Bunny is tickling* ***him***) or a reflexive (*Daffy Duck says Bugs Bunny is tickling* ***himself***). Across numerous picture pointing studies, children with SLI indeed show poorer comprehension compared with control children (Bishop, Bright, James, Bishop, & van der Lely, 2000; Montgomery & Evans, 2009; Norbury, Bishop, & Briscoe, 2002; van der Lely, 1998; van der Lely & Stollwerck, 1997).

Pronominal and reflexive sentences could pose difficulty for children with SLI because of trouble using binding principles (Chomsky, 1995). Principle A states that a reflexive item (*Daffy Duck says Bugs Bunny*$_i$ *is tickling* ***himself***$_i$) must be bound in its governing category, with *bound* meaning coindexed (*i*) or locally bound to an antecedent. The reflexive must refer to the noun within the same clause. The principle allows the child to build a short-distance syntactic dependency between the anaphor and its antecedent. In the previous sentence, a child would interpret the reflexive *himself* as referring to the local antecedent, *Bugs Bunny*. Principle B states that a pronoun (*Daffy Duck*$_i$ *says Bugs Bunny is tickling* ***him***$_i$) must be free in its governing category such that the pronoun may refer only to a nonlocal antecedent. The anaphor cannot refer to a noun in the same clause. In this case, a long-distance syntactic relationship must be built. A child should interpret the anaphor *him* in the previous example to refer to the distant antecedent, *Duffy Duck*. Children with SLI are less consistent than their age-matched and language-matched peers at using these principles (van der Lely, 1996). Thus, the difficulty children with SLI have with anaphoric binding presumably leads them to bind an anaphor to either a local or a nonlocal antecedent, which in turn leads to unreliable comprehension.

Passive and Object Relative Sentences

Children with SLI also have trouble understanding reversible *be* passive and object relative (OR) structures. Both structures are noncanonical in nature because they

violate typical SVO word order of English. Each of these structures requires syntactic movement and the building of a long-distance syntactic dependency.

Because reversible *be* passives (*The baby$_i$ was kissed [t$_i$] on the head by the lady*) are noncanonical in nature, they cannot be comprehended using canonical word order. According to the linguistic account, comprehension of passive and OR sentences requires a syntactic movement operation in order to establish a nonlocal syntactic (filler-gap) dependency (Chomsky, 1995). In the previous sentence, NP1 (*the baby*) originally is the complement of the verb *kissed* but gets moved to the specifier position of the tense phrase through a process referred to as *argument movement.* The relationship between *the baby* and its original position in the sentence (marked as ***t*** for trace) is specified via a process of coindexing (***i***). NP2 (*the lady*) appears in an adjunct prepositional *by* phrase (*by the lady*), with the agent role being transmitted from the passive morpheme (*-ed*) to the NP in the *by* phrase (Guasti, 2002). Because the passive morpheme receives the thematic role of the external argument, the thematic role cannot be assigned to another NP; rather, it gets expressed in an adjunct prepositional phrase (PP). This transmission operation is expressed by coindexing the passive morpheme and the *by* phrase (Guasti, 2002). Verb tense is held as a constant through movement of the auxiliary *was* from the verb position. The passive participle *kissed* maintains its verb position. It is this movement operation that is hypothesized to be problematic for children with SLI, leading them to poorer comprehension relative to same-age peers (Bishop et al., 2000; Montgomery & Evans, 2009; Precious & Conti-Ramsden, 1988; van der Lely, 1996; van der Lely & Harris, 1990) and, in some instances, younger vocabulary-matched children (Norbury et al., 2002; van der Lely, 1996; van der Lely & Harris, 1990). The poorer comprehension of the SLI group relative to the vocabulary-matched group may be related to possible poorer syntactic knowledge of the children with SLI. Other studies, however, have reported no difference between younger, vocabulary-matched and STM-matched children and children with SLI, even on full *be* passives (e.g., Montgomery & Evans, 2009).

Not all passives are difficult for children with SLI (van der Lely, 1996). Semantic cues can override syntactic difficulties. Nonreversible passives (*The milk was spilled by the boy*) pose no problems as children are able to use semantic and real-world cues in the sentences, making it clear that children should assign the thematic role of agent to an animate NP. Likewise, comprehension of short ambiguous passives (*The fish was eaten*) is not a problem, presumably because the children adopt an adjectival interpretation such that in the previous sentence, *eaten* is interpreted as a stative verb (i.e., an adjective) rather than a passive participle.

OR Sentences

Study of OR sentence comprehension in English-speaking children with SLI is scarce (Adani, Forgiarini, Guasti, & van der Lely, 2014; Dick, Wulfeck, Krupa-Kwiatkowski, & Bates, 2004; Hestvik, Schwartz, & Tornyova, 2010). However, cross-linguistic evidence shows that Greek-speaking (Stavrakaki, 2001), Hebrew-speaking (Friedmann & Novogrodsky, 2004, 2007), and Swedish-speaking (Håkansson & Hansson, 2000) children with SLI all have trouble comprehending ORs.

OR sentences (*The boy$_i$ that the girl kissed [t$_i$] on the cheek ran away smiling*) are difficult for children with SLI because these structures also involve movement and the establishment of a filler-gap dependency. According to the linguistic account, NP1 (*the boy*) must be moved from its fronted object position to its rightful postverbal canonical position (*the girl kissed [t$_i$] the boy*). At this point, NP1 is reactivated at the gap and integrated into the developing syntactic and verb argument structure such that the verb (*kissed*) can then assign a proper thematic role to each NP. Across various studies using different testing methods, children with SLI consistently perform poorer on OR comprehension compared with same-age peers.

Summary of the Syntax-Specific Deficit Account

Across studies examining sentence comprehension involving binding or movement, children with SLI show reliably poorer comprehension compared with same-age peers and many younger language-matched children, presumably because of a difficulty computing nonlocal, long-distance syntactic dependencies. In the case of poor reflexive/pronominal sentence comprehension, it has been hypothesized that children with SLI have trouble with anaphoric binding, leading them to bind an anaphor to either a local or a nonlocal antecedent. For sentences involving movement, children with SLI appear to be inconsistent in building hierarchical grammatical structures because they treat the obligatory movement operation as optional. In both instances, these linguistic failures lead to compromised comprehension.

Working Memory–Based Account

As a counter position to a syntax-specific deficit view, other researchers have argued for a WM account (Epstein, Hestvik, Shafer, & Schwartz, 2013; Leonard, Deevy, Fey, & Bredin-Oja, 2013; Montgomery, 2000b; Montgomery & Evans, 2009; Norbury et al., 2002; Robertson & Joanisse, 2010). Four reasons have motivated this alternative position. First, researchers coming from a more psycholinguistic tradition have come to study SLI sentence comprehension from a broader perspective, viewing comprehension as an interaction of linguistic-specific and more general cognitive processing abilities. A psycholinguistic perspective encompasses the study of the influence of WM because the construct of WM incorporates a range of potentially theoretically relevant mechanisms to comprehension. Second, regarding the CGC hypothesis, the proposal offers no clear explanation about why children with SLI should treat movement as optional. Third, the majority of CGC-motivated studies have not rigorously tested for memory influences on comprehension. Fourth, the hypothesis has trouble accounting for the broader profile of SLI comprehension deficits

that include poor comprehension of noncanonical structures as well as simpler canonical structures. A WM-based account assumes an association between the sentence comprehension and memory limitations of these children.

WM Defined

WM is the ability to temporarily maintain information in an active state while performing some kind of mental activity. WM is a robust predictor of a wide range of cognitive abilities, including fluid intelligence, problem solving, and reasoning (Cowan et al., 2005; Engle, Tuholski, Laughlin, & Conway, 1999; Kane, Conway, Bleckley, & Engle, 2001). Numerous models of WM exist, including the multicomponent model (Baddeley, 1999, 2012; Baddeley & Logie, 1999), embedded processes model (Cowan, Rouder, Blume, & Saults, 2012; Cowan, Saults, & Blume, 2014), dual store model (Engle et al., 1999; Shipstead, Lindsey, Marshall, & Engle, 2014; Unsworth & Engle, 2007), and time-based resource-sharing model (Barrouillet, Gavens, Vergauwe, Gaillard, & Camos, 2009; Barrouillet, Portrat, & Camos, 2011; Portrat, Barrouillet, & Camos, 2008). The central issues in WM research concern defining the capacity limits of WM and identifying those factors that constrain capacity (e.g., item decay, item interference, and item retrieval).

Baddeley's multicomponent model (Baddeley, 2012) includes four separable yet interactive components. One is a domain-general central executive. The executive was conceived of as an attentional supervisor, controlling activities across the WM system, with no storage abilities. The executive was fractionated into different attentional functions such as focus, dividing attention, switching, and interfacing with long-term memory (LTM). The second and third mechanisms correspond to two domain-specific storage devices, one devoted to the temporary retention of verbal material (phonological loop) and the other devoted to visuospatial input (visuospatial sketchpad), which are representations activated in LTM. A fourth component, the episodic buffer (Baddeley, 2000, 2001), was incorporated into the model later to account for a range of findings showing participants' ability to engage in concurrent information storage and processing and to account for the interface between WM and LTM. As such, the buffer is assumed to comprise a storage device that is responsible for retaining cross-modal inputs as well as a processing capability to bind these multidimensional codes into coherent chunks or episodes.

The models of Cowan and colleagues (Cowan et al., 2012, 2014), Engle and colleagues (Engle et al., 1999; Shipstead et al., 2014; Unsworth & Engle, 2007), and Barrouillet and colleagues (Barrouillet et al., 2009, 2011; Portrat et al., 2008) differ in detail, but they share two common traits. One is that WM contains multiple embedded processes (rather than modules as in the Baddeley model) that all contribute to a general capacity, which represents the number of memory units or representations activated in LTM. In a recent reformulation of his model, Cowan et al. (2014) defined *capacity* as the sum of central storage and peripheral storage. Central storage (focal attention) is limited to no more than one categorizable item (e.g., word). Peripheral storage involves modality-specific memory of verbal items or visual items. In terms of Engle and colleagues' dual store model, central and peripheral storage are conceptually and functionally analogous to the constructs of primary memory and secondary memory. The second common trait is attention, but its operations differ across models. Attention for Cowan et al. (2005) plays a zooming role, with the focal attention zooming out to capture several items during encoding and then zooming in to maintain fewer items in the focus of attention at any given moment. Like Baddeley (2012), Engle and colleagues (Engle et al., 1999; Shipstead et al., 2014; Unsworth & Engle, 2007), and Barrouillet and associates (Barrouillet et al., 2009, 2011; Portrat et al., 2008) emphasize the controlling functions of attention. For Engle and colleagues, individuals use attentional control to maintain items in the focus of attention (primary memory) while also searching and selectively reactivating items that lie just outside focal attention (secondary memory). For Barrouillet and colleagues, attentional control relates to rapid and alternating switching of focal attention between storage to maintain and refresh items in memory (usually a single item) and completing the processing component of a WM task.

In the present review article, we center primarily on the role of verbal memory storage in comprehension because storage is the component that has dominated research in SLI comprehension. Also, we focus on storage in general because we are not concerned about whether storage is conceived of as a series of distinct mental actions with distinct verbal and nonverbal pathways (Baddeley, 1999; Gathercole & Baddeley, 1990) or a process of momentarily focusing attention on items in central storage and/or reactivating items from outside focal attention (Cowan et al., 2014; Engle et al., 1999; Shipstead et al., 2014; Unsworth & Engle, 2007).

The vast majority of SLI memory research has been conducted within Baddeley's framework, with verbal WM storage being conceptualized and measured in two broadly different ways: simple memory storage and complex memory storage. Simple storage reflects children's ability to temporarily hold in mind phonological material. In simple storage tasks, children hear or see strings of items and are asked to remember and recall the strings in serial order, with no requirement to perform any other activity. Nonword repetition is a common simple storage task in which children repeat nonwords that vary in length. Digit spans and word spans are also common tasks. Compared with same-age peers, children with SLI show marked deficits in simple verbal memory storage, evidenced by poorer nonword repetition or reduced digit and word spans, implying reduced phonological memory capacity (Archibald & Gathercole, 2006, 2007; Montgomery & Evans, 2009; Norbury et al., 2002).

In complex verbal WM tasks, children must store verbal information while performing a processing activity. A common complex memory storage task is a listening span task. In one kind of task, children are presented blocks of sentences for which they need to process the truth value

of each sentence. Immediately following the last sentence in a block, children recall as many sentence-final words as they can. Such tasks invite children to use their controlled attention to manage the storage and processing demands. Children presumably must update the list of items to be stored with each new sentence and rapidly switch their attention between information processing (gleaning the truth value of a sentence) and refreshing the items in storage. Relative to same-age peers, children with SLI exhibit significantly more limited verbal WM storage, as evidenced by reduced item recall (Archibald & Gathercole, 2006, 2007; Ellis Weismer, Evans, & Hesketh, 1999; Montgomery, 2000b).

Research exploring the association between verbal WM and sentence comprehension in children with SLI has used various simple and complex storage tasks. We focus on the relation between verbal WM storage and performance on experimental sentence comprehension tasks. We report on experimental comprehension measures because they have been developed with some kind of linguistic and/or memory motivation in mind.

Role of Simple Storage in SLI Sentence Comprehension

The idea of a simple memory storage deficit hypothesis of SLI comprehension assumes that children with SLI lack sufficient storage to retain important contrastive lexical detail in the input. Loss of such detail can lead to compromised comprehension.

Montgomery (1995) completed the first experimental study examining the relation of simple storage and sentence comprehension in SLI. Children with SLI and same-age peers completed a nonword repetition task indexing simple storage capacity and a picture pointing comprehension task. Sentences were syntactically similar long and short SVOs. The long SVOs included extra verbiage (*The short fat clown is holding the little yellow balloons*) or one or two reduced dependent clauses (*The furry cat [that is] standing is biting the brown mouse; The fat clown [that is] laughing is hugging the girl [that is] crying*). The short sentences did not include extra verbiage. On the nonword task, the SLI group performed worse than controls. In comparison with TD controls, the SLI group comprehended a similar number of short sentences but significantly fewer long sentences. A positive correlation between storage and comprehension emerged in the groups combined, suggesting that a simple memory storage deficit in the children with SLI hindered their ability to retain important lexical details associated with each NP, thus compromising comprehension.

Robertson and Joanisse (2010) assessed the relation between simple storage and comprehension in children with SLI and age-matched controls. Sentences, short and long, included SVOs, subject relatives, and ORs. Comprehension was assessed using a picture selection task, with pictures appearing in three conditions increasing in memory load: (a) 2 s prior to the onset of the sentence and throughout sentence presentation, (b) immediately after the sentence, and (c) 3 s after the sentence. The SLI group performed significantly worse than age-matched peers on both the nonword repetition and sentence comprehension tasks. A significant correlation between simple storage and overall sentence comprehension (groups combined) was also reported in the second and third memory load conditions, implying that comprehension was associated with simple storage capacity.

Leonard et al. (2013) provided the first experimental evidence implicating lexical interference as a factor influencing simple memory storage and sentence comprehension in SLI. Children with SLI and same-age peers were compared on the comprehension of SVOs systematically varying in length. Length was manipulated by including NP-modifying adjectival material. For the low-demand items, children heard sentences containing no adjectives (*The bunny chases the cat*). For the intermediate-demand items, sentences included prenominal adjectives (*The nice mouse covers the pretty bird*); however, the adjectives offered no contrastive value about which NP served as agent and which as patient. For the high-demand items, children heard similar sentences, but this time the adjectives lent contrastive value that was important to comprehension (*The yellow dog washes the white pig*). It was hypothesized that a difference in accuracy between the SLI and age-matched groups would increase in magnitude between the intermediate- and high-demand sentences. Predictions were confirmed. The SLI group significantly more often chose the foil picture most closely resembling the target sentence picture with respect to the NP-modifying adjectival material, especially for the high-demand items. The authors thus argued that sentence comprehension in children with SLI may be more vulnerable to lexical interference when sentences include competing lexical information.

Findings from these studies imply an association between simple memory and sentence comprehension in SLI. However, this conclusion must be tempered because some of the studies reported memory-comprehension correlations that were based on combined groups and combined sentence structures. A study by Montgomery and Evans (2009) overcame these problems to provide findings addressing the specific role of simple storage. An SLI group and two control groups, one matched on age and the other a younger group matched on simple storage and vocabulary, were studied. The comprehension task included complex sentences (passives: *The woman is painted by the girl;* pronominals/reflexives: *Winnie the Pooh says Christopher Robin is touching him*, *Baloo Bear says Bugs Bunny is tickling himself*) and SVOs (*The old man is touching the blue-haired woman*). Correlation results revealed that simple storage related to SVO comprehension and not complex sentence comprehension, but only in the SLI group. Such results suggest that comprehension of even fairly short SVOs containing contrastive lexical material invites significant simple memory storage in children with SLI but not in same-age or younger TD children.

Role of Complex Memory in SLI Sentence Comprehension

A complex memory storage deficit hypothesis of SLI comprehension rests on the assumption that children with SLI have insufficient storage to retain the products of prior

processing as they engage in downstream processing. In this view, complex structures requiring binding or syntactic movement should invite complex storage, but not for SVO structures because interpretation of these structures can be comprehended using a simple left-to-right processing strategy, with thematic roles being automatically assigned to each NP once the verb is processed.

Interesting findings about the differential role that complex storage might play in the comprehension of canonical and noncanonical sentences were reported by Montgomery and Evans (2009). Children completed a complex span task—the competing language processing task (CLPT; Gaulin & Campbell, 1994). The CLPT is a conventional listening span/complex memory task in which children listen to groups of sentences in which the number of sentences included in the group increases. They are asked to judge the truthfulness of each sentence as it is presented (the comprehension component of the task) and then must remember the final word in each sentence within the group (the memory storage component). The SLI group performed worse than age-matched peers on the memory component but similarly to younger children. Correlation analyses revealed that performance on the CLPT significantly correlated with passive sentence comprehension in the SLI and younger groups but not the older group. Complex storage did not correlate with SVO sentence comprehension in any of the groups. Results were taken to mean that the comprehension of short passives requires complex memory storage for SLI and younger memory-vocabulary-matched children. The sentences required the children to retain NP1 until it needed to be reactivated (moved) to the specifier position of the tense phrase later in the sentence, the point at which the children could create a long-distance syntactic dependency. It may be that, relative to age-matched controls, the SLI and younger groups had trouble retaining and/or reactivating NP1 to create the dependency.

Two recent experimental online sentence processing studies offer additional evidence implicating the role of complex memory in the poorer comprehension of noncanonical (OR) structures by children with SLI. These studies are the first to focus on the role of complex memory storage in real-time sentence processing as well as memory retrieval. Hestvik et al. (2010) examined the immediate gap-filling abilities of children with SLI and control peers as they listened to OR sentences (*The camel that the rhino in the mud had kissed* $_{[probe]}$ *on the nose ran far away*). Recall that OR processing requires retention of two unintegrated NPs (which we assume lie just outside focal attention) until processing of the embedded verb. It is at this point that NP1 must then be reactivated from memory to establish a long-distance fill-gap dependency.

To assess NP1 reactivation, children performed a cross-modal picture priming task in which they listened to an OR sentence (or filler sentence) and saw a probe picture occurring at the gap or a pregap location. The probe picture was a picture of either NP1 (primed probe) or another animal not mentioned in the sentence (control probe). Successful memory storage and NP1 reactivation from memory were inferred from a speed advantage of the primed probe over the control probe at the gap. The SLI group showed no speed advantage for the primed probe, but the TD children did. The authors interpreted the results to mean that children with SLI failed (or at least were slower) to reactivate NP1. Relative to the TD group, the SLI group may have been more sensitive to the absence of distinctive retrieval cues discriminating NP1 over NP2 as the item to be reactivated and therefore were more prone to retrieval interference, as evidenced by a lack of a speed advantage for the primed probe. We take up retrieval interference in the next section.

An event-related potential (ERP) study by Epstein et al. (2013) lends further support for the suggestion that children with SLI are slow to create a filler-gap dependency in real time. An SLI group and a TD group were compared. Children first heard a sentence containing a relative clause (*The bear that the gorilla followed in the woods hid behind the tree*) followed by a subject *wh*-question (*Who$_i$ [t$_i$] followed the bear?*) or an object *wh*-question (*Who$_i$ did the gorilla follow [t$_i$]?*). ERP waveforms were gathered during *wh*-question presentation to measure whether children showed evidence of retention of the *wh*-filler in memory for object *wh*-questions compared with subject *wh*-questions. The hypothesis was that, relative to subject questions, object questions require the *wh*-filler to be held over a longer distance, subjecting it to decay. ERP findings showed a large and broad sustained anterior positivity for object questions versus subject questions in the control group. However, this effect was greatly diminished and nonsignificant in the SLI group. The authors took the finding of reduced processing of object questions by the SLI group to suggest that these children have difficulty retaining sentential information in WM during the processing of object *wh*-questions.

The interpretation of these findings is in keeping with the interpretation of an earlier offline study by Deevy and Leonard (2004), who compared the comprehension of subject *wh*-questions and object *wh*-questions in an SLI group and a younger group of vocabulary-matched children. Children listened to short and long subject questions (*Who$_i$ [t$_i$] is feeding the tiger?; Who$_i$ [t$_i$] is feeding the big orange tiger?*) and object questions (*Who$_i$ is the tiger feeding [t$_i$]?; Who$_i$ is the big orange tiger feeding [t$_i$]?*). Children were asked to point to the referent doing the action in an image depicting the animals. The hypothesis was that the SLI group should perform poorly on the object questions, especially the longer ones; the extra verbiage would place a greater load on storage because the *wh*-phrase must undergo a longer distance movement than in the shorter object questions. The prediction rests on the assumption that children need to retain the *wh*-phrase in memory until encountering the syntactic gap downstream, at which point the correct referent could be identified. Results supported the hypothesis. The groups did not differ on the long and short subject questions. However, the SLI group performed significantly worse on the long object questions versus

short object questions compared with control children and relative to themselves, implicating the involvement of memory. Findings from these last three studies align well with neuroimaging studies that show an overlap in brain regions supporting WM and language performance in children with SLI (Ellis Weismer, Plante, Jones, & Tomblin, 2005) and adults (Grossman et al., 2001; Hestvik, Maxfield, Schwartz, & Shafter, 2007), suggesting a functional association between WM and comprehension.

Role of Controlled Attention in Sentence Comprehension

Research exploring the relation of controlled attention and sentence comprehension in SLI is nearly nonexistent. Because many models of WM include controlled attention as a key component, we speculated that the sentence comprehension problems of children with SLI might also, in part, be related to poor attentional control.

Emerging evidence suggests that children with SLI exhibit deficits across a range of attention abilities (Henry, Messer, & Nash, 2012). Relative to age-matched peers, children with SLI show poorer attention allocation under demanding processing conditions (Leclercq, Majerus, Prigent, & Maillart, 2013; Montgomery, 2000b; Montgomery, Evans, & Gillam, 2009), sustained attention (Finneran, Francis, & Leonard, 2009; Montgomery, 2008; Montgomery et al., 2009; Spaulding et al., 2008), inhibition (Im-Bolter, Johnson, & Pascual-Leone, 2006; Marton, Kelmenson, & Pinkhasova, 2007; Victorino & Schwartz, 2015), attention shifting (Lum, Conti-Ramsden, & Lindell, 2007), and memory updating (Im-Bolter et al., 2006). It is noteworthy that these attention components are also common to some models of WM (Engle & Kane, 2004; Miyake et al., 2000). On the basis of some earlier reports of controlled attention deficits, we conducted two preliminary studies to explore sustained attention and attention allocation in SLI sentence comprehension.

We asked whether sustained attention might be important on the assumption that children need to maintain attention on what is being said over the course of a sentence. Children with weaker sustained attention might show poorer comprehension than those with stronger sustained attention. Attentional allocation was thought to be relevant because comprehension presumably involves children being able to effectively allocate their attentional resources to processing the spoken input and developing an appropriate linguistic representation of the input while simultaneously processing and interpreting the visual stimuli on the picture selection task. Children who have trouble allocating attention to both verbal and visual processing might be expected to show poorer comprehension compared with children with better allocation abilities.

Montgomery et al. (2009) explored the relation of sustained attention and attentional allocation to sentence comprehension in children with SLI and same-age peers. Sustained attention was indexed by performance on an auditory continuous performance task. Children also completed a three-tier verbal processing-storage task (index of allocation). Children heard lists of words (*nut, bike, tree, plane*) and were asked to recall the words in three different conditions: (a) serial order, (b) semantic category, and (c) semantic category with items recalled by physical size. The comprehension task included simple SVOs (*The dirty little boy climbed the big tall green tree)* and complex SVOs containing one or two dependent clauses (*The girl smiling is pushing the little boy; The boy standing is kissing the little girl sitting*). For the SLI group, simple sentence comprehension was significantly correlated with sustained attention, whereas complex comprehension was correlated with attention allocation. For the controls, neither attention ability correlated with comprehension. Results suggested that comprehension of SVO structures demands significant attention resources in children with SLI but not in TD children. However, there are three alternatives to explain the poorer performance in children with SLI. First, the complex sentences invited greater attention not just because they included embedded clauses but also because they required the processing of two semantically reversible arguments, one associated with the main verb phrase (VP) and one associated with the embedded VP. Second, the sentences included truncated relative clauses (*The boy smiling is kissing the little girl crying*), not fully expressed clauses (*The boy who is smiling is kissing the little girl who is crying*). The children with SLI may not have interpreted the sentences as containing fully expressed clauses but instead as SVOs containing postmodified NPs (*the boy smiling = the smiling boy; the girl crying = the crying girl*). If so, the children would have adopted a noncanonical NP processing strategy rather than the intended structuring of the participles (*smiling, crying*) as part of a relative clause. Adopting such a strategy may have been enough to cause the children's poor comprehension. Even so, such a strategy still invited greater attention from the children. Third, the SLI group may have interpreted the truncated relative clauses as fully expressed clauses, which would implicate poor syntactic knowledge. Last, in a similar study examining the role of sustained attention in real-time SVO comprehension (Montgomery, 2008), sustained attention was found to correlate with SVO processing in children with SLI but not in same-age TD children.

Leclercq et al. (2013) offered converging evidence of an association between attention allocation and comprehension in SLI. Children with SLI, same-age peers, and younger grammar-matched children completed a comprehension task in isolation and in a dual-load condition in which they also had to respond to the random presence of a dot appearing on a computer screen. In the dual task, children needed to allocate their attention between comprehension and visual detection. In the dual-load condition, comprehension was disproportionately affected in the SLI group compared with the same-age peers. By contrast, the children with SLI and younger controls performed similarly in the no-load and dual-load comprehension conditions.

Summary of the Memory-Based Account

A memory-based account assumes a direct association between the sentence comprehension and memory (storage,

attention) deficits in SLI. Accumulating evidence suggests that there is an association. This claim is based on differences between children with SLI and controls in comprehension patterns and/or correlation patterns: Comprehension is often correlated with memory and attention in children with SLI but is not always correlated in control children. However, in its present form, this account has severe limitations. Next, we outline these limitations and offer a new framework motivated by both current adult models of sentence comprehension and relevant SLI findings.

Looking Ahead: Future Directions in SLI Sentence Comprehension Research

Much is still unknown about the association between the sentence comprehension and memory deficits in children with SLI. Several factors appear to be limiting our understanding. First, previous research has been conducted in widely different ways, leading to an absence of a unified memory-based framework of SLI sentence comprehension. Second, WM is a complex construct conceptualized in different ways by different authors. As such, SLI researchers have not always been explicit about the guiding model being used, the memory mechanisms selected for study, or how the mechanisms might be relevant to comprehension. Third, the sentences used across studies have varied greatly, making it difficult to draw clear conclusions about the role of memory in comprehension. Fourth, claims of an association have been based on correlation findings (and not always computed on groups or sentence types separately) and on differences in comprehension patterns between children with SLI and same-age and younger control groups. Fifth, past studies have used small samples, making it impossible to conduct formal modeling that could shed light on the memory underpinnings of sentence comprehension. Last, few studies have attempted to isolate the specific syntactic processing abilities of children with SLI independent of semantic factors. As a consequence, direct comparison of the merits of the syntax-specific deficit and memory-based accounts of SLI sentence comprehension has been hindered.

We argue that much can be learned about the relation of sentence comprehension and memory in children with SLI by expanding our research enterprise. We argue that SLI researchers should consider (a) designing studies within a new, more theoretically integrated memory-based framework that we propose below (doing so would enable researchers to select memory mechanisms known to be theoretically and empirically relevant to comprehension); (b) building broader, theoretically and empirically derived models of comprehension within the context of large-*N* psychometric modeling studies (i.e., studies with large numbers of participants); and (c) designing subsequent studies that are based on modeling results to more deeply focus on the influence of specific memory mechanisms. Such efforts would yield more complete, refined, and sensitive models of SLI comprehension.

WM-Based Framework of Adult Sentence Comprehension

A current framework in the adult literature conceptualizes comprehension within a broader, more theoretically integrated memory-based perspective. The framework is explicitly informed and constrained by various memory mechanisms (E. Gibson, 1998; Gordon, Hendrick, & Johnson, 2001; Gordon, Hendrick, & Levine, 2002; Lewis, Vasishth, & Van Dyke, 2006; McElree, 2000; McElree, Foraker, & Dyer, 2003; Van Dyke, 2007; Van Dyke & Lewis, 2003; Van Dyke & McElree, 2006, 2011). We believe that this framework, with proper modification as described later, offers SLI researchers a new, more powerful framework to better understand the nature of SLI sentence comprehension.

The assumption underlying this framework is that many of the same memory mechanisms subserving and constraining WM performance also subserve and constrain sentence comprehension. Key mechanisms in the framework include (a) a sharply limited attentional focus (i.e., information chunks that occupy focal attention or are just outside but still in a "reactivation-ready" state and available to be pulled back into the focal attention), (b) item decay, and (c) rapid item retrieval. These models also include two LTM systems: declarative and procedural. Declarative memory relates to the lexicon and its associated contents about words and intermediate syntactic structures (e.g., VP-gap). Procedural memory contains grammatical knowledge and the processing schemes that are activated during sentence comprehension. These memory systems are assumed to be intact and operate automatically.

Experimental findings suggest the following about these memory mechanisms in the comprehension of noncanonical structures. First, memory storage appears to have minimal influence because listeners have the capacity to hold at least two unintegrated constituents (NPs) in mind prior to integrating them into a developing syntactic structure such as a filler-gap dependency (Hestvik et al., 2010; Lewis et al., 2006). Second, it has been argued that item decay (forgetting of NP1) exerts little influence on the first-pass processing of a sentence, during which a listener builds initial sentence structure and meaning (Van Dyke & Lewis, 2003). Decay can be a factor if a listener needs to revise an initial structural analysis or misinterpretation. Third, rapid item retrieval is the result of a direct access mechanism that enables an item in memory to be immediately retrieved during processing on the basis of the cues available at retrieval (McElree, 2000). Item retrieval (i.e., NP1 reactivation), however, is strongly influenced by similarity-based retrieval interference (Gordon et al., 2001, 2002; Lewis et al., 2006; Van Dyke, 2007; Van Dyke & Lewis, 2003; Van Dyke & McElree, 2006, 2011). If the cues available at retrieval are not sufficiently distinctive to reactivate the target over competing syntactically and/or semantically similar items also in memory, then retrieval interference arises. Under these conditions, an inappropriate NP may be retrieved, and comprehension is compromised. However, when sufficient cues are available, similarity-based retrieval

interference is reduced or even eliminated (Van Dyke & McElree, 2011).

Applicability of the Adult Framework to Studying SLI Sentence Comprehension

Although models of adult sentence comprehension assume fully developed and intact syntactic and memory systems, they may still inform our thinking about children's sentence comprehension. Such models, however, will require modification to ensure their sensitivity to developmental aspects of childhood sentence comprehension. We also must be sensitive to the assumptions of particular theoretical stances about WM because each model makes different assumptions about the nature of WM, which may influence how we go about developing our research programs. Given no shortage of WM models, SLI researchers have two options for how to proceed. One is to align oneself with a particular stance, selecting the most theoretically relevant memory components and determining the contribution of each to sentence comprehension. As an alternative, one could take a more agnostic approach and (a) select components from various models believed to be relevant to comprehension and (b) incorporate those into the models (Lewis et al., 2006). We envision at least three phases of future SLI comprehension research.

Phase 1: Psychometric Modeling Studies

A critical first phase is to build empirically grounded psychometric models of comprehension to identify the contributions of the most relevant memory mechanisms to children's comprehension. Such modeling efforts will require specific design features such as (a) large-N groups carefully matched on demographic variables such as age, gender, family income, and family education to control for potentially confounding moderating factors; (b) inclusion of two or more measures to index each relevant memory construct to create appropriate latent memory variables; and (c) selection of modeling approaches such as structural equation modeling to yield the most stable, informative, and sensitive models. Such modeling approaches have been used successfully to model (a) the structure of children's WM (Gathercole, Pickering, Ambridge, & Wearing, 2004), (b) the executive functions of WM in adults (Miyake et al., 2000), and (c) sentence comprehension in adults (Swets, Desmet, Hambrick, & Ferreira, 2007).

A range of sentence structures should be modeled, including canonical and noncanonical. This approach would provide important data about whether different memory clusters support the comprehension of different structures and—more important—whether similar or different memory clusters support the comprehension of children with SLI and TD peers and whether various memory abilities play a direct or mediating role. Initial efforts should use sentences that are carefully controlled for semantic influences. For example, using semantically implausible, length-controlled sentences that violate typical predicate–argument expectations and natural affordances between NPs (*The train that the knife had helped under the square was cold*) would illuminate children's syntactic processing abilities (Montgomery, Evans, Gillam, Sergeev, & Finney, 2016). More important, such sentences would provide the strongest comparative test of the syntax-specific deficit account versus the memory-based account. The syntax-specific deficit hypothesis would be supported if the modeling results showed that the memory mechanisms accounted for no significant variance in sentence comprehension. A second step would be to test the generalizability of the initial model by modeling the comprehension of semantically plausible sentences. Inclusion of a wide age (school age through adolescence) is also critical because it would enable us to determine (a) the developmental trajectory of sentence comprehension in these children and whether children with SLI begin to close the gap relative to their peers and (b) potential age-related changes in the use of various memory abilities supporting comprehension, both across and within groups.

What memory abilities might we include? Lexical knowledge and grammatical knowledge (indices of language-related declarative and procedural LTM) would be crucial. Lexical knowledge could be indexed by performance on various receptive and expressive measures of vocabulary knowledge that reflect both single-word knowledge and the breadth and depth of the lexical–semantic network. Likewise, grammatical knowledge could be indexed by performance on a range of standardized sentence-level receptive and expressive tasks measuring syntactic knowledge. One such measure is sentence recall (Jeffries, Ralph, & Baddeley, 2004; Potter & Lombardi, 1998). Recent findings by Boyle, Lindell, and Kidd (2013) revealed that TD children's sentence repetition predicts the comprehension of noncanonical sentences. Assessment of children's statistical learning abilities is also crucial given recent evidence suggesting that children with SLI have implicit statistical learning deficits (Evans, Saffran, & Robe, 2009; Hsu & Bishop, 2011; Hsu, Tomblin, & Christiansen, 2014). Statistical learning is a hallmark characteristic of the procedural LTM system present in the adult model of sentence comprehension (Lewis et al., 2006). Tasks assessing accuracy and speed of learning adjacent and nonadjacent dependencies (resembling those of English syntactic structure) would yield important information about these children's ability to learn the statistical regularities of syntax. Limited focus of attention could be assessed by performance on such measures as running digit span or running visual span (in which children are presented a random string of digits or objects and asked to periodically recall a string of items) or phonological binding (in which children are asked to make associations or *bindings*) between nonwords and non-speech sounds (Gray et al., 2017). Such measures index children's ability to maintain a limited number of items squarely in the focus of attention.

Sentence comprehension requires the immediate access from LTM of the phonological representations associated with incoming words. Inclusion of speeded lexical access measures would appear to be important. These measures could be rapid automatic naming (i.e., speed of picture naming) and spoken word recognition (i.e., speed of picture recognition). In addition, children's verbal WM

abilities could be included. Different measures such as the auditory working memory subtest of the Woodcock–Johnson III Tests of Cognitive Abilities (Woodcock, McGrew, & Mather, 2001) and listening span–like measures such as the CLPT (Gaulin & Campbell, 1994) could be used. Such measures would provide a global index of children's ability to coordinate concurrent verbal processing and storage—a requirement of noncanonical sentence comprehension.

Controlled attention mechanisms believed to be relevant to sentence comprehension should also be incorporated. Attention focus switching would seem to be a reasonable candidate mechanism to include. Attention switching relates to the idea of zooming in and out of central (primary) and peripheral (secondary) storage to expand the number of to-be-remembered and recalled items. Applied to language processing, attention focus switching might be important to the comprehension of noncanonical structures such as full *be* passives and ORs. In the case of passives, children must retain NP1 while processing material appearing downstream. In ORs, children must hold both NP1 and NP2 until encountering the embedded VP. We might argue that the comprehension of such structures invites attention switching because children must momentarily switch their focus of attention away from the demands of current linguistic processing (e.g., processing embedded VP) to WM to reactivate NP1. Finney, Montgomery, Gillam, and Evans (2014) provided the first empirical evidence that focal attention switching is a significant predictor of TD children's real-time OR sentence comprehension (*The goat$_i$ that the pig had bumped [t$_i$] near the bush was smiling*). The authors argued that children must momentarily redirect their attention from processing the embedded verb (*bumped*) to WM to reactivate NP1 (*the goat*) to establish a long-distance syntactic dependency. Sustained attention might also be incorporated to evaluate the suggestion that sustained attention is involved in the sentence comprehension of children with SLI but not TD children (Montgomery et al., 2009).

Interference in the adult literature has proved to be a major factor constraining memory retrieval and noncanonical (OR) sentence comprehension, with the reliability of cues being a critical determinant of successful item retrieval. It has been shown that the availability of reliable syntactic and/or semantic cues at retrieval plays a major role in successful reactivation from memory of NP1 over its NP2 competitor during OR comprehension. Retrieval interference in the SLI comprehension literature is essentially nonexistent (however, see Leonard et al. [2013] for general lexical effects in SLI and Adani et al. [2014] for morphological effects in TD children). Our models of sentence comprehension must include such a memory construct. Interference tasks such as semantic interference probed recognition STM tasks and picture–word interference tasks (both indexing semantic interference) could be used. Such tasks are critically important to include given that retrieval interference would surely arise between NP1 and NP2 when comprehending semantically implausible sentences, especially noncanonical structures.

Phase 2: Quasi-experimental Studies

A second phase could take a more quasi-experimental approach similar to that used in the adult literature. The aim of such studies would be to gain deeper understanding of the influence of those memory abilities determined to be important to comprehension on the basis of the formal modeling results. One avenue of future quasi-experimental investigation could be real-time sentence comprehension. Real-time sentence processing studies in SLI are relatively scarce (Borovsky, Burns, Elman, & Evans, 2013; Epstein et al., 2013; Hestvik et al., 2010; Montgomery, 2000a, 2006, 2008). These studies could take different forms, including cross-modal picture priming (Hestvik et al., 2010), eye tracking (Borovsky et al., 2013), and ERP (Epstein et al., 2013; Hestvik et al., 2010). Such methods offer the advantage of manipulating sentence material in theoretically relevant ways, enabling researchers to ask a range of questions about the influence of memory on sentence comprehension. They also have the advantage of circumventing extraneous information processing requirements commonly associated with conventional picture pointing tasks (Montgomery, 2000b; Montgomery, Magimairaj, & Finney, 2010). For example, the time course of lexical activation and the nature of the initial word cohort that is activated on the basis of incoming phonological information (e.g., Marslen-Wilson & Tyler, 1980; Marslen-Wilson & Zwitserlood, 1989; Zwitserlood, 1989) could be determined. The temporal course of cohort reduction likewise could be evaluated. The time course of item (NP1) reactivation and the potential factors of item decay and item interference could be assessed by manipulating the distance and the amount or nature of linguistic material appearing between NP1 and the syntactic gap. Results from such efforts would provide new and important insights into the memory underpinnings of real-time sentence processing in children with SLI.

Phase 3: Experimental Studies

A third phase could take a more experimental approach. The aim of such studies would be to test hypotheses about the importance of particular memory and memory-related abilities for sentence comprehension that have grown out of the psychometric and quasi-experimental studies in phases 1 and 2. Experimental studies are important because their design enables researchers to test hypothesized cause-and-effect relationships. The strongest case for a causal relationship can be made from experimental research designs in which a memory ability precedes an effect (e.g., a change in attention control precedes a change in sentence comprehension) and covaries with an effect (e.g., the degree to which changes in attention control predict the extent of sentence comprehension change). Experimental studies are particularly important because well-designed studies enable investigators to control for alternative explanations for cause–effect relationships.

A number of studies have been conducted to determine the effect of a computer-assisted instructional program called Cogmed (2012) designed to affect children's general memory skills. Klingberg et al. (2005) compared

the performance of 7- to 12-year-olds on adaptive and nonadaptive versions of Cogmed. Findings suggested that children who had participated in the adaptive version of Cogmed made significantly greater gains on measures of visuospatial memory, digit span, and attention compared with children who received the nonadaptive version. Preliminary data suggest that Cogmed training may have the potential to affect WM performance. These results have been replicated in children with attention-deficit/hyperactivity disorder (Beck, Hanson, Puffenberger, Benninger, & Benninger, 2010; Chacko et al., 2013), low IQ (Kronenberger et al., 2011), hearing impairments (Van der Molen et al., 2010), low-level language abilities (Holmes et al., 2015), and poor WM (Holmes et al., 2010). Recent reviews of this literature (B. S. Gibson, Gondoli, Johnson, Steeger, & Morrissey, 2012; Shipstead, Redick, & Engle, 2012) and the results of a number of recent studies (Ang, Lee, Cheam, Poon, & Koh, 2015; van der Donk, Hiemstra-Beernink, Tjeenk-Kalff, van der Leij, & Lindauer, 2015; van Dongen-Boomsma, Vollebregt, Buitelaar, & Slaats-Willemse, 2014; Yu, Li, Liu, An, & Liu, 2015) unfortunately have cast some doubt on the idea that WM training really improves WM capacity. In addition, we know of no experimental evidence suggesting that Cogmed training generalizes to changes in sentence comprehension.

A stronger test for cause-and-effect relationships between memory and memory-related abilities and sentence comprehension would involve conducting early- and late-phase randomized clinical trials on training that was designed to affect a particular memory ability. For example, researchers could conduct a study in which 40 children with SLI are randomly assigned to two groups: an experimental group that receives instruction and practice on a dichotic listening task designed to improve attention control and a control group that does not receive any treatment. All children would receive a battery of attention, memory, and comprehension tests before and after the treatment period. The strongest case for a causal effect of controlled attention on the sentence comprehension skills of children with SLI would be related to findings that children in the attention treatment group had significantly better scores than children in the control group on attention, memory, and sentence comprehension measures only after treatment (cause precedes the effect) together with strong correlations between these measures across both groups before and after treatment (cause covaries with the effect). This type of randomized controlled trial would enable investigators to rule out a variety of alternative explanations related to subject selection, history, maturation, regression to the mean, reactive pretest, and others. Such experimental studies could provide compelling tests of hypotheses related to the nature of cause-and-effect relationships between memory abilities and sentence processing in children with SLI.

Summary

We briefly reviewed two perspectives on the sentence comprehension deficits of children with SLI. We have argued that the memory-based view is the better account for explaining the broad profile of comprehension problems in SLI. However, this account, in its present form, has numerous shortcomings given the theoretical and methodological differences across the reviewed studies. Current advances in the adult literature in the development of a more theoretically integrated memory framework of comprehension was reviewed briefly. On the basis of this framework, a new direction for SLI comprehension research was proposed. We also argued that with proper refinement and expansion of more current adult models, SLI researchers can begin to build broader, more theoretically motivated and integrated memory models of SLI sentence comprehension.

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